



## E X T R A C T

FROM A LECTURE ON

## THE NERVOUS SYSTEM,

BY

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ETC. ETC.

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LET me now call your attention to the true spinal, or excito-motory, system. I shall, in the first instance, confine myself to a detail of *experiments*; and I think I may therefore assert that what I shall state may be considered as physiologically demonstrated.

If, the head of an animal being removed, you irritate the spinal marrow, those muscles which receive nerves from *below* the point so irritated, are *excited* into a state of contraction. If, instead of irritating the spinal marrow, you irritate a muscular nerve in its course, the muscle or muscles to which this nerve is distributed, are, in like manner, excited into contraction.

Haller, who specially treated of this subject, denominated the power in the nervous system, which is thus called into activity, the *vis nervosa*<sup>1</sup>; the power of contraction in the muscular fibre, he termed its irritability, or the *vis insita*. Of the former he observes, "Irritato nervo, convulsio in musculo oritur, qui ab eo nervo ramos habet. Irritato vero nervo, multis musculis communi, totive artui, omnes ii musculi convelluntur, qui ab eo nervo nervos habent, *sub sede* irritationis ortos. Denique medulla spinali irritata, omnes artus convelluntur, qui *infra* eam sedem nervos accipiunt;

<sup>1</sup> Some writers having been misled, by this expression, to think there is a similarity in the views of Prochaska and my own, I must caution you that this *vis nervosa* of Haller is *not* the *vis nervosa* of Prochaska. I can scarcely tell you *what* the *vis nervosa* of Prochaska is, unless indeed it be *every thing*. It is something which is *augmented* in *mania* and in *gout*!

*neque* contra artus, qui *supra* sedem irritationis ponuntur." Haller concludes, "Conditio illa in nervo, quæ motum in musculis ciet, *desuper* advenit, sive a cerebro et medulla spinali, *deorsum*, versus extremos nervorum fines propagatur." And, "Ut adpareat causam motus a trunco nervi in ramos, non a ramis in truncum venire<sup>1</sup>." It was a mistake, as M. Flourens has shewn, to suppose that this power exists in the *cerebrum*.

This same power is more correctly denominated by Prof. Müller, the motorische kraft, or the *vis motoria*. This equally celebrated physiologist treats this subject still more at length, and has laid down the following laws in regard to the mode of action of the motor power:—

"1. The motor power acts *only* in the direction of the primitive nervous fibres going to muscles, or in the direction of the branches of the nerves; and *never backwards*.

"2. The mechanical or galvanic irritation of a part of a nervous trunk does not excite the motor power of the whole nerve, but only of the isolated part.

"3. A spinal nerve which passes into a plexus, and assists, with other spinal nerves, in the formation of a large nervous trunk, does not impart its motor power to the whole of that trunk, but only to the fibres which it affords in its course from that trunk to the branches.

"4. All nervous fibres act in an isolated manner from the trunk of a nerve to its ultimate branches<sup>2</sup>."

M. Flourens denominates this power the "*excitabilité*," and he has shewn more distinctly than any preceding physiologist, that it exists in the whole of the medulla oblongata and medulla spinalis, inclusive of the tubercula quadrigemina, but exclusive of the cerebrum and cerebellum; and, of course, in the muscular nerves.

These statements convey a true view of the condition of our knowledge on this subject when I first began my researches. The *anatomical limits* and the *course of action* of this motor power were understood to be those which I have thus stated from these celebrated physiologists.

<sup>1</sup> Elementa Physiologiæ, Lausannæ, t. iv. p. 325.

<sup>2</sup> Handbuch der Physiologie, i. 656; and Dr. Baly's Translation, i, p. 680.

That this statement is true, in reference to the subject of my researches, I am enabled to prove, by detailing an unsuccessful experiment made by Prof. Müller :

“ I wished,” says Prof. Müller, “ to ascertain whether the last of the spinal nerves, if they were divided at some distance from the spinal marrow, and galvanized, (their roots being still attached to this organ), would excite convulsive movements in the *anterior* parts, through the medium of the spinal marrow. The results were constant but unexpected.

“ Neither the anterior nor the posterior roots occasion, when they alone are acted upon by galvanism, retrograde action into the anterior parts of the animal frame, as of the head. It seems, therefore,” adds Prof. Müller, “ that the fibres of the nerves do not communicate in the spinal marrow<sup>1</sup>.”

Allow me now to call your attention to a series of experiments of my own. If, in a turtle, its head having been previously removed, we carefully lay bare the intercostal nerves, and pass across them the galvanic influence, we immediately induce movements in *all* the extremities, *the anterior* and the posterior. If we choose a nerve near the anterior extremities, these are most moved; if near the posterior, these, in their turn, are most affected. This experiment, as you will perceive shortly, forms the *basis* of the system of incident, excitor, motor, or excito-motory nerves.

That the source or principle of action in this experiment is identical with that already noticed, as acting in the spinal marrow and in the muscular nerves, is proved by an intermediate experiment. If, in a decapitated turtle, instead of laying bare the intercostal nerve, we denude the spinal marrow, and pass the galvanic influence across its substance, we also excite contractions in the *anterior* as well as posterior extremities<sup>2</sup>.

We have thus traced the influence of the “ *vis nervosa*”

<sup>1</sup> Handbuch der Physiologie, 1833, t. i., p. 632; Translation, p. 645.

<sup>2</sup> A similar experiment was performed both by M. Flourens and Prof. Müller; (see *Système Nerveux*, 113; *Handbuch*, t. i., p. 632, omitted in the *Trans.*); but in these experiments the animal was not decapitated; the action of the special motor power could not therefore be distinguished from the influence of *sensation and volition*; and the experiment is, therefore, *not the same*.

of Haller, the "*vis motoria*," the "*excitabilité*," in a retrograde direction in the spinal marrow itself, and in an incident and retrograde direction in the intercostal nerves and the spinal marrow.

In this latter case we have, I think, a new kind of action, and, physiologically speaking, a new kind of nerve, that is, an *incident motor action*, and an *incident motor nerve*.

May I not affirm that this statement is the pure expression of *facts*, and destitute of *all hypothesis*? for I speak not of *fibres* or of *filaments*, about which there has been so much discussion; but of an obvious action in an obvious nerve. These two things are as "demonstrated" as any in physiology.

This incident motor nerve, thus *demonstrated*, is but one of a *System* of incident nerves, of which I must speak to you. But, before I proceed to that subject, allow me to detain you one moment, to say that what I have just stated is *not* to be found in the admirable works of *Prochaska*, or of *M. Flourens*, or of *any* physiologist with whose labours I am acquainted. Yet it is, as I have stated, the *basis* of that *System of nerves* and, I may add, of *functions*, to which I have alluded; it is that basis without which that system could not be satisfactorily established.

I have hitherto spoken of the *trunk* of one of the incident, excitor, or motor nerves. But I must now inform you that the extreme terminations or distributions of these nerves possess the excitor or motor, or, as I have ventured to express it, the excito-motory power, in a much higher degree than their trunk. If, having removed the head of a frog, you divide the integuments along the back, and raise them by means of the forceps, you will observe the trunks of many cutaneous nerves; now, if you irritate these trunks, no movements follow; but, if you irritate the cutaneous textures on which they are distributed, movements of a very energetic character are produced. (See my *Memoirs*, p. 48, § 21.)

I now proceed with my detail of the series of experiments on the decapitated turtle. If you irritate the nostrils, or the palatine fringes, you excite, through the *trifacial nerve*, an act of inspiration. If you irritate the larynx by passing a probe along the trachea, you produce the same effect through

the medium of the *pneumogastric* nerve. A similar phenomenon is produced by irritating the trunk of the pneumogastric, or the substance of the spinal marrow, near the points of their division respectively.

Have not these experiments proved, without one word of argument, the existence of *other two incident* nerves possessing *the special excito-motory property*? Do you not perceive the beginnings of *the System of incident excitor nerves* to which I have alluded?

Do you not further perceive that these nerves are not only excitors of muscular action, but, in the case last detailed, of *the act of inspiration*? And do you not now plainly see the application of the "*vis motoria*," the "*excitabilité*," and of the System of incident nerves, through the medium of which it acts, to *Physiology*?

This *System* of nerves is further displayed in *this* Diagram and Table, and the *extensive Class of functions*, for such it is, of which it is the *Anatomy*, is displayed in this Table.

Until the period of my researches, I believe that the pure motor power of the nervous system had never been applied to physiology—that the idea of an *incident motor* nerve did not exist; and, consequently, that the System of such nerves, and the special Physiology of this system, was totally unknown.

Why do I mention these things? Because it has been eagerly attempted to transfer the credit of what I have done to others, and especially to Prochaska on the one hand, and to M. Flourens on the other. But I will ask you, whether the idea of an *incident motor* nerve exists in either of these authors? and, if not, whether the *system* of such nerves, with their *physiology*, can exist in them. In fact, Prochaska goes no further than Whytt; he alludes to a *reflex* action, as seen in the *very obvious pathological* phenomena of sneezing, coughing, &c. and then all is confusion; for with these phenomena are associated, as of a *similar* character, the motion of the arm to the head *said* to take place in apoplexy! the motion of the eye-lids when a person approaches your eye with a finger! the motion of the *heart!* of the *intestines!* &c. It is impossible to argue with persons of such confusion of

ideas. And for M. Flourens, he does not make the slightest allusion to an *incident* motor action, or an *incident* motor nerve, or to a *reflex* action ; and yet all the functions to which I now refer, *are* reflex, and effected by means of such a power and through the medium of such nerves ! On the contrary, M. Flourens states a thousand times in his beautiful work, which is a model of physiological investigation, that respiration, for example, has its *primum mobile* in the medulla oblongata. It *has* its *primum mobile* in *incident excitomotory nerves*.

Now let me return to this table and diagram.

*Anatomy of the True Spinal, or Excito-motory System.*

I. *The Incident, Excitor Branches.*

1. *The Trifacial, arising from—*

1. *The Eye-lashes.*
2. *The Alæ Nasi.*
3. *The Nostril.*
4. *The Fauces.*
5. *The Face.*

2. *The Pneumogastric, from*

1. *The Pharynx.*
2. *The Larynx.*
3. *The Bronchia.*
4. *The Cardia,—Kidney, and Liver.*

3. *The Posterior Spinal, arising from—*

1. *The General Surface.*
2. *The Glans Penis vel Clitoridis.*
3. *The Anus.*
4. *The Cervix Vesicæ.*
5. *The Cervix Uteri.*

II. *The True Medulla Oblongata and Medulla Spinalis, the Centre of the System.*

III. *The Reflex, Motor Branches.*

1. *The Trochlearis* } *Oculi.*

2. *The Abduens* }

3. *The Minor portion of the Fifth.*

4. *The Faecial, distributed to*

1. *The Orbicularis.*
2. *The Levator Alæ Nasi.*

5. *The Pneumogastric or its Accessory.*

1. *The Pharyngeal.*

2. *The Œsophageal.*

3. *The Laryngeal.*

4. *The Bronchial, &c.*

6. *The Myo-glossal.*

7. *The Spinal, distributed to the*

1. *Diaphragm, and to*

2. *The Intercostal and* } *Muscles.*

3. *The Abdominal*

8. *The Sacral, distributed to*

1. *The Sphincters.*

2. *The Expulsors, Ejaculators, the Fallopian Tubes, the Uterus, &c.*

All the nerves represented on this, the left side of the Table, are *incident motor nerves*. Some of them are *sentient* ; but, whether sentient or not, they are demonstrably *motor*, and, whilst they are *motor* they are *incident*. I beseech you not to allow these two words—these two ideas—to be disjoined in your mind ; and there will then be an end of all dispute.

And now let me recall your attention to this Table.

*Physiology of the Reflex, Excito-motory System.*

*The Action*—1. *Of the Eye-lids.*

2. *Of the Orifices.* } 1. *The Larynx.*  
                                  } 2. *The Pharynx.*

3. *Of the Ingestion.*

1. *Of Food.*

1. *In Suction ;*

2. *In Deglutition.*

2. *Of Air.*

3. *Of Semen.*

4. *Of Exclusion.*

5. *Of the Expulsors, or of Egestion.*

1. *Of the Fæces ;* 2. *Of the Urine ;*

3. *Of the Semen ;* 4. *Of the Fætus.*

6. *Of the Sphincters.*

It presents you with the *physiology* which corresponds to the *anatomy*. It presents you with an arrangement of the functions of *ingestion* and *egestion*, of the *orifices* and of the *sphincters*. No one has pretended, except in the vaguest manner, and under the shelter of the phrase “*sympathetic actions*,” that this extensive view of the subject had been taken before. Prof. Müller distinctly states (Trans. p. 803) that the *reflex actions* have a limited place in *physiology*. Prochaska does not name *one* of these functions! M. Flourens does not name *one* of them!! And certainly no one has traced these functions to the *incident* action of the *vis motoria*, in *incident* and purely *motor* nerves, for the very existence of such nerves were unknown. In a word, gentlemen, it was impossible to explain the anatomy or the physiology of *deglutition*, of *inspiration*, of the various *expulsions*, until I published my discoveries of the true spinal marrow, and the excito-motory system of nerves.

What shall I say of the *Pathology* of this system? It was impossible that such facts as teething and tetanus, facts as *obvious* as those already mentioned, should have been otherwise than associated with the nerves. How could *the whole Class of spasmodic diseases*,—*centric*, *centripetal*, and *centrifugal*, (to use words not my own), be traced to, and associated with, a part of the nervous system, still unknown? One of the most beautiful facts which I shall have to explain to you, is that of the very parts or organs enumerated in the physiology, being precisely those involved in the pathology;

so that you have, in many instances, but to recall the former, in order that you may recollect the latter, and in this manner you will be greatly assisted in remembering the *symptoms* of the class of spasmodic diseases.

In conclusion, I must observe that the true spinal or excito-motory system, being the system of ingestion and expulsion, of the orifices and sphincters, is the system of actions on which depend

- I. *The Preservation of the Individual*<sup>1</sup>, and
- II. *The Continuation of the Species.*

It is in this large and extensive sense that the excito-motory system must be viewed, if we would see its real magnitude and importance. It is in this sense that it will be viewed by the anatomists and physiologists of a future age.

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<sup>1</sup> I must again guard my reader against supposing that I use the first of these phrases in the sense in which Prochaska has used a similar phrase. Prochaska adduces, as an example of what he means, the acts of sneezing, cough, vomiting, which certainly tend to *remove* what would be injurious, and may be supposed to effect "*nostri conservatio.*"

FINIS.





